

Schem. 6.
Fig. 3.

And that this is true, not onely in one, but in every Ray that goes to the constitution of the Primary Iris; nay, in every Ray, that suffers only two refractions, and one reflection, by the surface of the round body, we shall presently see most evident, if we repeat the *Cartesian Scheme*, mentioned in the tenth *Section* of the eighth *Chapter* of his *Meteors*, where *E F K N P* in the third Figure is one of the Rays of the Primary Iris, twice refracted at *F* and *N*, and once reflected at *K* by the surface of the Water-ball. For, first it is evident, that *K F* and *K N* are equal, because *K N* being the reflected part of *K F* they have both the same inclination on the surface *K* that is the angles *F K T*, and *N K V* made by the two Rays and the Tangent of *K* are equal, which is evident by the Laws of reflection; whence it will follow also, that *K N* has the same inclination on the surface *N*, or the Tangent of it *X N* that the Ray *K F* has to the surface *F*, or the Tangent of it *F Y*, whence it must necessarily follow, that the refractions at *F* and *N* are equal, that is, *K F E* and *K N P* are equal. Now, that the surface *N* is by the reflection at *K* made parallel to the surface at *F*, is evident from the principles of reflection; for reflection being nothing but an inverting of the Rays, if we re-invert the Ray *K N P*, and make the same inclinations below the line *T K V* that it has above, it will be most evident, that *K H* the inverse of *K N* will be the continuation of the line *F K*, and that *L H I* the inverse of *O X* is parallel to *F Y*. And *H M* the inverse of *N P* is Parallel to *E F* for the angle *K H I* is equal to *K N O* which is equal to *K F Y*, and the angle *K H M* is equal to *K N P* which is equal to *K F E* which was to be prov'd.

So that according to the above mentioned *Cartesian* principles there should be generated no colour at all in a Ball of Water or Glafs by two refractions and one reflection, which does hold most true indeed, if the surfaces be plain, as may be experimented with any kind of prisme where the two refracting surfaces are equally inclin'd to the reflecting; but in this the *Phænomena* are quite otherwise.

The cause therefore of the generation of colour must not be what *Des Cartes* assigns, namely, a certain rotation of the *Globuli ætherei*, which are the particles which he supposes to constitute the *Pellucid medium*, But somewhat else, perhaps what we have lately supposed, and shall by and by further prosecute and explain.

But, First I shall crave leave to propound some other difficulties of his, notwithstanding exceedingly ingenious *Hypothesis*, which I plainly confess to me seem such; and those are,

First, if that light be (as is affirmed, *Dioptr. cap. 1. §. 8.*) not so properly a motion, as an action or propension to motion, I cannot conceive how the eye can come to be sensible of the *verticity* of a *Globule*, which is generated in a drop of Rain, perhaps a mile off from it. For that *Globule* is not carry'd to the eye according to his formerly recited Principle; and if not so, I cannot conceive how it can communicate its rotation, or circular motion to the line of the *Globules* between the drop and the eye. It cannot be by means of every ones turning the next before him; for if so, then onely all the *Globules* that are in the odd places must be turned the same way

way with the first, namely, the 3. 5. 7. 9. 11, &c. but all the *Globules* interposed between them in the even places; namely, the 2. 4. 6. 8. 10. &c. must be the quite contrary; whence, according to the *Cartesian Hypothesis*, there must be no distinct colour generated, but a confusion. Next, since the *Cartesian Globuli* are suppos'd (*Principiorum Philosoph. Part. 3. §. 26.*) to be each of them continually in motion about their centers, I cannot conceive how the eye is able to distinguish this new generated motion from their former inherent one, if I may so call that other wherewith they are mov'd or *turbinated*, from some other cause than refraction. And thirdly, I cannot conceive how these motions should not happen sometimes to oppose each other, and then, instead of a rotation, there would be nothing but a direct motion generated, and consequently no colour. And fourthly, I cannot conceive, how by the *Cartesian Hypothesis* it is possible to give any plausible reason of the nature of the Colours generated in the thin *lamina* of these our *Microscopical Observations*; for in many of these, the refracting and reflecting surfaces are parallel to each other, and consequently no rotation can be generated, nor is there any necessity of a shadow or termination of the bright Rays, such as is suppos'd (*Chap. 8. §. 5. Et preterea observavi umbram quoque, aut limitationem luminis requiri*; and *Chap. 8. §. 9.*) to be necessary to the generation of any distinct colours; Besides that, here is oftentimes one colour generated without any of the other appendant ones, which cannot be by the *Cartesian Hypothesis*.

There must be therefore some other propriety of refraction that causes colour. And upon the examination of the thing, I cannot conceive any one more general, inseparable, and sufficient, than that which I have before assign'd. That we may therefore see how exactly our *Hypothesis* agrees also with the *Phænomena* of the refracting round body, whether *Globe* or *Cylinder*, we shall next subjoyn our *Calculation* or *Examen* of it.

And to this end, we will calculate any two Rays: as for instance; let *E F* be a Ray cutting the *Radius C D* (divided into 20. parts) in *G* 16. parts distant from *C*, and *e f* another Ray, which cuts the same *Radius* in *g* 17. parts distant, these will be refracted to *K* and *k*, and from thence reflected to *N* and *n*, and from thence refracted toward *P* and *p*; therefore the Arch *F f* will be 5.^d 5'. The Arch *F K* 106.^d 30'. the Arch *f k* 101.^d 2'. The line *F G* 6000. and *f g* 5267. therefore *h f*. 733. therefore *F c* 980, almost. The line *F K* 16024. and *f k* 15436. therefore *N d* 196. and *n o* 147 almost, the line *N n* 1019 the Arch *N n* 5.^d 51'. therefore the Angle *N n o* is 34.^d 43'. therefore the Angle *N o n* is 139.^d 56'. which is almost 50.^d more than a right Angle.

It is evident therefore by this *Hypothesis*, that at the same time that *e f* touches *f*. *E F* is arrived at *c*. And by that time *e f k n* is got to *n*, *E F K N* is got to *d*, and when it touches *N*, the pulse of the other Ray is got to *o*, and no farther, which is very short of the place it should have arriv'd to, to make the Ray *n p* to cut the orbicular pulse. *N o* at right Angles: therefore the Angle *N o p* is an acute Angle, but the quite contrary